THE USE OF ICT IN ORAL HEALTH CARE DELIVERY IN CAMEROON

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KEYWORDS

ICT, oral health, internet, software application, oral health promotion, Cameroon.

ABSTRACT

Background: Cameroon like other countries in the Central African subregion is not just faced with specialist oral health manpower, but also remarkable shortage of oral health information. Today, Information and Communication Technology (ICT) touches all aspects of our daily life and it can be a channel for promoting general and oral health. By leveraging digital tools and platforms, a wider audience can be reached, enhancing the provision of valuable health information thereby creating oral health awareness.
Aim: To carry out a baseline field assessment of the impact of ICT on the promotion of oral health among adults in Cameroon.
Methodology: A descriptive prospective study was conducted in the national territory of Cameroon from November 2019 to July 2020. An internet oral healthcare education software application featuring basic oral health information with recommended oral health practices was developed. The link of the software was widely disseminated via the internet to the national territory of Cameroon via several social media handles and websites. The software had a questionnaire that was used to test the baseline oral health knowledge and practices of the participants. Sensitization or oral health education was caried out through the various internet handles and after two months of oral health education, the same questionnaire was used to evaluate participants' oral health knowledge levels and practices.
Results: A total of 4312 adults participated in the study, but only 3778 participants made up of 2176 (57.6%) men and 1451 (38.4%) women completed both the pre-test and and post-test questionnaire, representing a response rate 96%. Devices used were smartphones (43.19%), computers
(36.07%), tablets (20.81%). ; Over eighty per centof study participants had never used ICT to obtain oral health information. After sensitization, tooth brushing in the mornings before meals had significantly reduced from 1518 (39%) to 286 (7.8%), compared to tooth brushing in the mornings after meals which increased from 652 (16.2%) to 1346 (36.6%). Tooth brushing in the evening after meals had increased from 1042 (26.8%) to 1654 (45%). (55%) affirmed that ICT is a potential tool to improve oral health knowledge. Nearly half 698 (45%) did not see the use of ICT as a useful tool for improving medical knowledge. Additionally, behavioural outcomes and knowledge levels had significantly increased by 48.42% and 71% respectively. The average knowledge test scores increased from 6.18 ± 3.79 to 18.13 ± 2.72.
Conclusion: This study demonstrated the positive impact that ICTs could have on the promotion of oral health in adults.

1. Introduction

Oral health is often neglected as people place less emphasis on the care of their teeth and gums compared to other parts of their body (1,2). This enhances their susceptibility to dental caries, periodontal diseases and precancerous lesions. This neglect may not be due to poor oral hygiene practices or unhealthy diets, but is also associated to lack of oral health education. Oral health impacts on general health as many diseases of the oral cavity are affected by the same determinants of general health (2). The World Health Organization (WHO) has made efforts to develop strategies that are aimed at building strong oral health policies towards effective control of risks to oral health, based on the common risk factors approach. This has been done by integrating oral health programmes into other Noncommunicable disease (NCD) programmes (1).

In developing countries, oral health programmes and policies are often absent or relegated to the background because of the burden of infectious and non-communicable diseases. This is mainly due to budget constraints, and to a focus on infectious diseases which form the bulk of diseases in these countries (1). Oral diseases remain a major public health concern. However, these diseases are preventable, therefore strategies to mitigate this burden, especially in developing countries are warranted. ICT brings together various techniques used in the processing and transmission of information, mainly through computers, internet and other telecommunications means (4). The use of online platforms for health promotion greatly increased during the period COVID-19 confinement where people used many online health platforms to disseminate health information and as well as search for authentic health information. Online platforms can be used for completion of pre-screening forms online and video consultations with a dental professional. In essence, it has emphasized that information technology and health care can work hand-in-hand (Maret et al., 2020) (5).
In contemporary medicine, health promotion, the regulation, prevention, information, control, screening, and training in health care can be improved considerably by the use of ICT. This is because ICT enhances the transmission of information and feedback from health care professionals and the population through devices like Smartphones, tablets, and smart watches (4). Despite all efforts involved in creating awareness campaigns to promote good oral health, orofacial diseases still remain the fourth prevalent diseases worldwide (1). It has been reported that ICT can be used to improve health-promoting lifestyle behavior, physical and mental health (5). However, there is a paucity of knowledge on comprehensive health-promoting lifestyle behaviors beneficial for the control and prevention of NCDs in low-income and middle-income countries (6).
Cameroon ranks the 57th country in the world in the use of mobile phones. Among the 22 million inhabitants of the country in 2017, it was estimated that 20.14 million people, representing a 90% land mass coverage had subscribed to an ICT device (7). Meanwhile, the use of ICT in oral health promotion in Cameroon like other African countries remains unexplored. The present study was carried out to determine the impact of ICT on the promotion of oral health among adults in Cameroon.

Methodology
This study was reported according to the strobe guidelines for cross-sectional studies (8). This descriptive prospective study was carried out in the national territory of Cameroon from November 2019 to July 2020. Adults residing in Cameroon during the study period, who used at least a smartphone, tablet, or computer daily and had access to a telephone network for calls, SMS, and internet connection and to the mobile application or the oral health website created for the study were included in the present study. Individuals who did not complete the 2nd phase of evaluation were excluded.
Sampling
A volunteer sampling method using snowball sampling was employed to select study participants and a minimum sample size of 384 was obtained using the Lorenz formula.
Data collection
The pretested survey was disseminated through WhatsApp, Facebook , Instagram, Snapchat, emails, SMS and a website created for oral health education. The data collection phase was done in three phases:

First stage: To obtain baseline information on the knowledge and practices of the study population on oral health. The questionnaire with open- and close-ended questions was used to collect information such as socio-demographic characteristics of adults using ICT, the impact of ICTs on the knowledge, attitudes and practices of study participants and elements impacting the use of ICTs as a medical resource.

The second stage involved an education phase on oral health for two months after the baseline data was collected and analysed. Website and mobile applications were used to educate the study population about tooth decay, gum disease and oral cancer, using short messages, videos, and audios.

Third phase: The survey was repeated with the same questionnaire used in the baseline study.

Statistical analyses
Data collected with Microsoft Excel were analysed using SPSS^{R} version 26.0. The normality of quantitative data distribution was assessed using the Kolmogorov–Smirnov test. Quantitative data are presented as the mean value and standard deviation for normally distributed data or the median value and interquartile range for skewedly distributed data. Categorical data are presented as frequencies and percentages. The Chi-squared test

or Fisher's test was employed to examine associations between categorical variables, $p<0.05$ was considered statistically significant.

Ethical clearance was obtained from the institutional ethics committee of the Universite des Montagnes (Ethical Clearance N ° 2019/003 / UdM / PR / CIE),

3. Results

Socio-demographic profile of the study participants.

A total of 4312 adults participated in the study. There was a 96% response rate of those who completed both phases of the study (n= 3778). Just over half 2176 (57.6%) were men and 1451 (38.38%) women. Devices used included smartphones (43.19%), Computers (36.07%) and Digital tablets (20.81%). A third 1144 (30.3%) were aged between 26-35 years, 27.3% between 16-15 years; and and 1540 (40.7%) married. Almost half1765(46.7%) worked in the in-formal sector, 1310 (37.4) in the formal sector; two thirds 2342 (62.0%) had university education, 735 (19.4%) secondary education 307 (8.1%) primary education (Table 1).

Table 1: Socio-demographic profile of the study participants

Age range	**Frequency**	**Percentages (%)**
16 – 25	1032	27.3
26 – 35	1144	30.3
36-45	402	10.6
46-55	666	17.6
56 and above	534	14.1
Area of work		
Informal sector	1765	46.7
Formal sector	1310	34.7
Unemployed	125	3.3
Student	**828**	**21.9**
Marital status		
Married	**1640**	**43.4**
Single	**1546**	**40.9**
Divorced	**282**	**7.5**
Widow(er)	**310**	**9.7**
Level of education		
School dropouts	394	10.5
Primary	307	8.1
Secondary	735	19.4
University	2342	62.0

Oral health seeking behaviour changes before and after oral health education

Where to seek help when a participant experienced a lump in the mouth?

When asked "where to seek help when a participant experienced a lump in the mouth", 1151 (31.7%) responded "a dentist", and post oral health education, the figure increased to 3452(95.2%). With regards to those who responded general medical practitioner 1542(42.5%) initially, only 320 (8.8%) responded general medical practitioners' post-education (Figure 1).

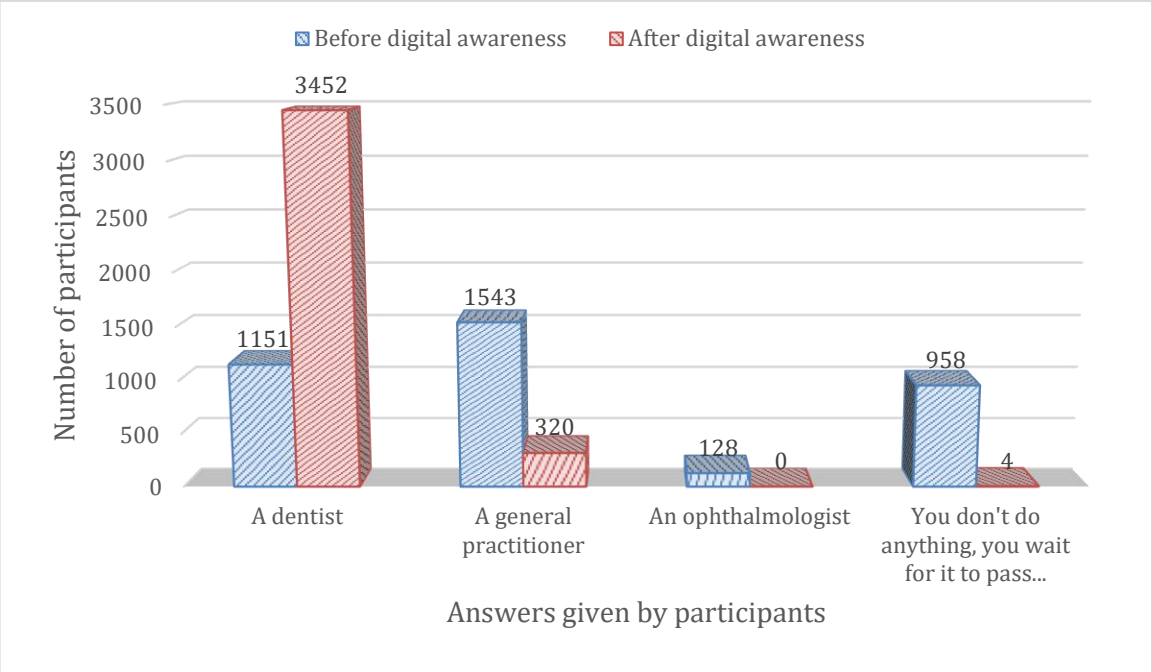

Figure 1: "Who do you consult when you notice a painless lump on the inside of your lip".

Time to spend before renewing your toothbrush

Participants awareness of when to change their toothbrushes increased from 1440 (38.1%)before the study to 3700 (97.9%) after oral education (Table 2).

Table 2: "How long before and after you renew your toothbrush", before and after the awareness session

	Before digital awareness N(%)	**After digital awareness N(%)**
Every 7 days	101(2.6)	12(0.3)
Every month	1069(28.3)	58(1.5)
Every 3 months	1440 (38.1)	3700(97.9)
Never	529(14.0)	0(0.0)
I don't know.	639(16.9)	8(0.2)
Total	**3778(100.0)**	**3778(100.0)**

Length of time for quality brushing

Participants who gave the correct response to this question increased from 982 (26%) to 3016 (79.83%) after oral health education (Figure 2).

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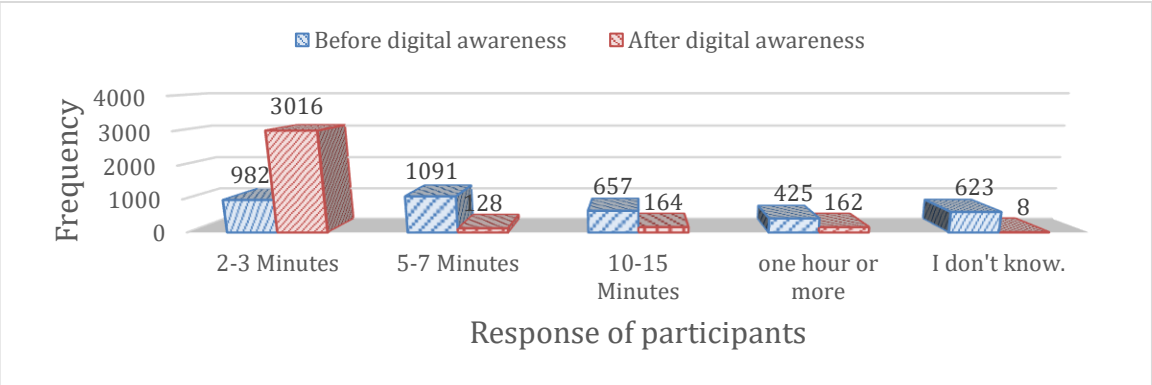


Figure 2: "How long should quality brushing be carried out"

When should you start brushing your baby's teeth?

After oral education, the participant response of "As soon as the first milk teeth appear in the mouth" increased from 670 (17.7%) to 3600 (95.3%) after digital awareness. When asked when to brush, participants who gave the correct answer: " immediately or 30 minutes after the meal" increased from 764 (20.2%) to 3568 (94.4%). There was also an increase in knowledge level from 1487 (39.36%) to 3312 (87.66%) after the digital awareness debunking the myth that dental caries is contagious. Regarding fluoride as being the essential component of toothpaste, the positive response increased from 1203 (31.84%) to 3651 (96.64%) after sensitization. Additionally, participants who responded that toothpaste was not necessary dropped from 628 (16.62%) to 0 (0%). Awareness that a baby can be born with a neonatal tooth, increased from 830 (22%) to 3254 (86.1%) after oral education.

Responding false to the question "there is no need to care on baby's teeth" increased from 1572 (41.61%) to 3498 (92.57%) after the digital awareness phase (Figure 4).

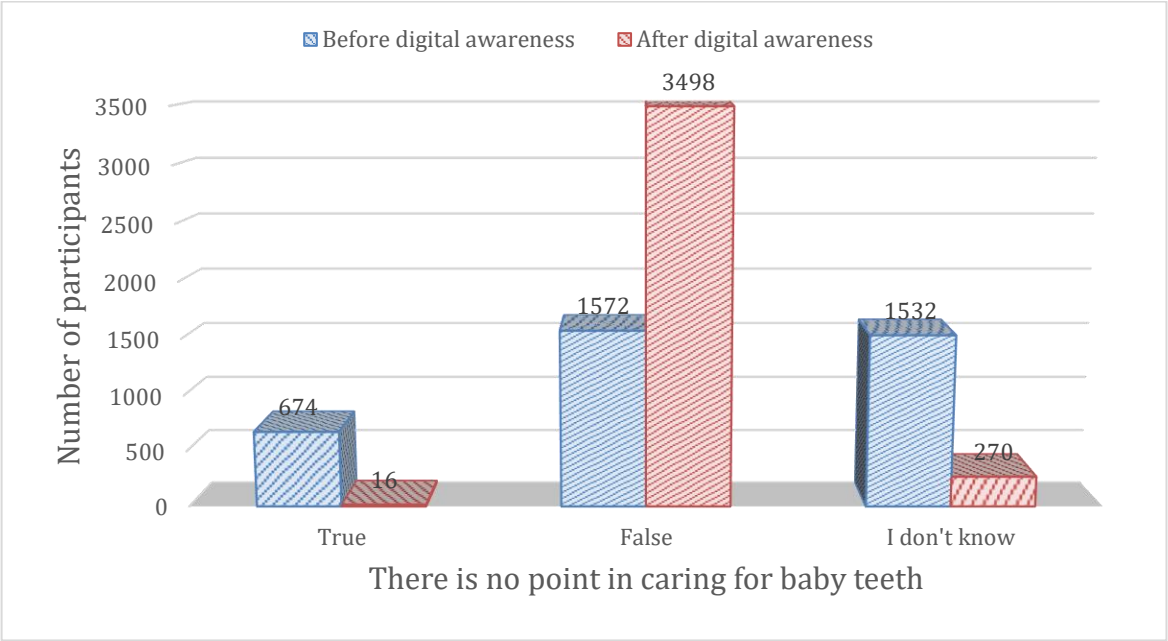


Figure 3: Comparison of participants' answers to the question: "There is no point in caring for baby teeth", before and after awareness raising.

With regards to the overall knowledge assessment, participants an "Excellent" level of knowledge significantly increased from 98 (2.59%) to 2787 (73.74%) (Table 3).

Table 3: Overall assessment of the impact of ICTs on participants' knowledge

Level	**Before digital awareness (n) (%)**	**After digital awareness (n) (%)**
Insufficient [0-10[	3104(82.16)	47(1.22)
Fair [10-12[	382(10.08)	42(1.11)
Good enough [12-14[	94(2.49)	152(4.02)
Good [14-16[	77 (2.01)	234 (6.19)
Very good [16-18[	23(0.61)	518(13.71)
Excellent [18-20[	98(2.59)	2787(73.74)
Total	3778 (100.0)	3778(100.0)

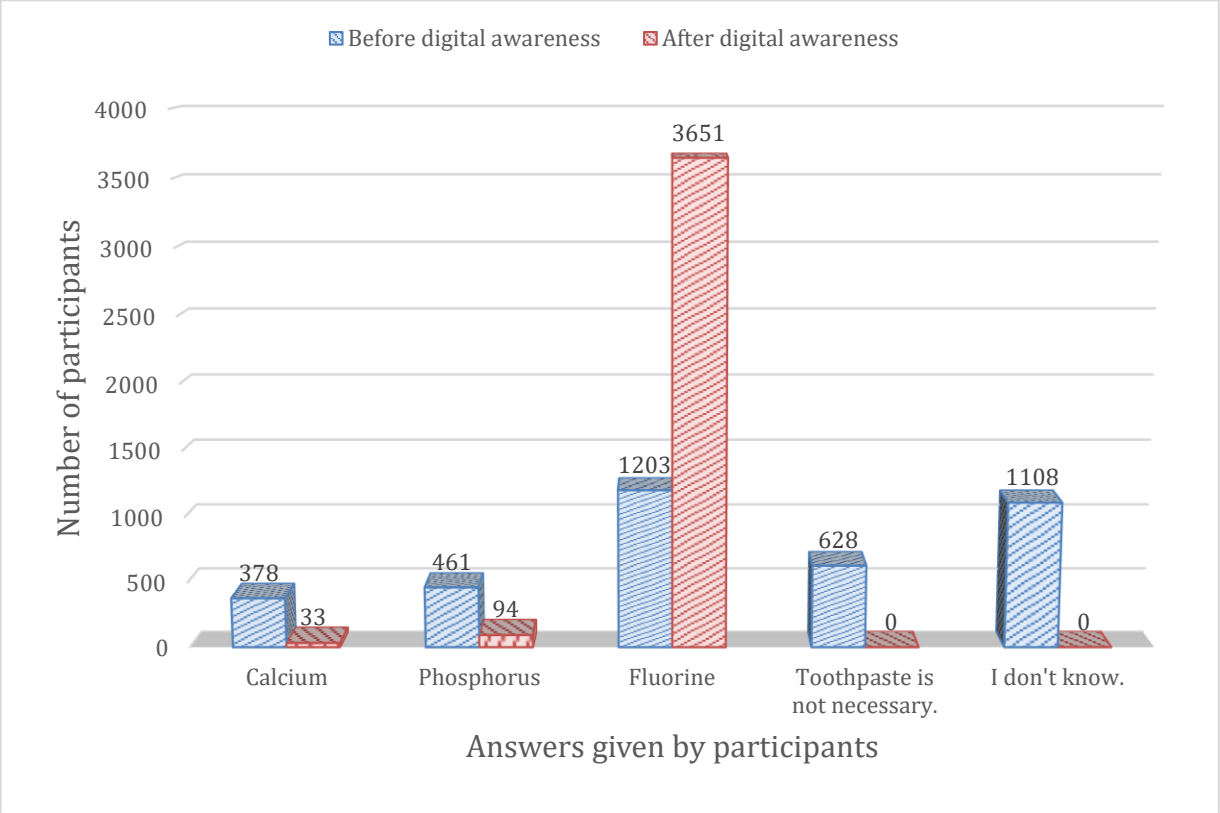
Impact of ICTs on attitudes and practices of the study participants

Participants who reported brushing their teeth daily increased from 2726 (72.2%) to 3200 (84.7%).

In terms of products used by those who brush their teeth regularly, the use of charcoal, green clay and lemon juice decreased from 618 (16.36%) to 16 (0.42%); from 214 (5.66%) to 4 (0.1%) and from 404 (10.69%) to 10 (0.26%), respectively.

Brushing twice daily increased from 768(20.32%) to 812(21.49%). There was no significant change. Comparison of participants' response to the question: "What element of toothpaste is essential for protecting the teeth?" the responses with the correct answer, “Flouride” increased from 1203(33.1%) before to 2351(64,8%) after raising awareness (Figure 4).

I.1.1.1. Toothpaste element essential for dental protection



igure 4: Comparison of participants' answers to the question: "What element of toothpaste is essential for protecting our teeth?", before and after awareness-raising

Tooth Brushing

Participants who brushed their teeth in the morning before meal reduced from 1518(39%) to 286(7.8%) while those who brushed their teeth in the morning after meal and in the evening increased from 652(16.2%) to 1346(36.6%) and from 1042(26.8%) to 1654(45%) respectively (Table 4).

Table 4: Comparison of brushing moments

Responses	Before digital awareness **N(%_**	After digital awareness **N(%)**
Morning before eating	1518 (39.0)	286(7,8)
Morning after eating	652(16.7)	1346(36.6)
Noon	160(4.1)	8(0.2)
Evening	1042 (26.8)	1654(45.0)
From time to time	376 (9.7)	370 (10.1)
After each meal	146 (3.7)	12(0.3)
Total	3894(100.0)	3676(100.0)

Oral health seeking behaviour among the study participants

Two months after raising awareness, 3422(90.6%) participants felt they needed a dental consultation. The main reason (43%) for the consultation was for dental check-up (Table 5).

Table 5: Reasons why participants feel they need a dental consultation

Need for dental consultation	**Number of participants**	**Percentages(%)**
Yes	3422	90.6

No	356	9.4
Reasons for consultations		
I want a dental workup	2084	43.0
I have a pain in my mouth	821	17.3
I need a scaling and polishing	979	20.6
Total	4758	100.0

Overall assessment of the impact of ICTs on participants' skills and practices

Before the digital education phase, participants with an "Insufficient" score decreased from 2850 (75.44%) to 1470 (38.91%). A third 1698 (44.94%) did not see the use of ICT as a useful tool for improving medical knowledge because they felt it could give misleading information 580(34.2%). Only 18(1.1%) gave "dissatisfaction" as the reason (Table 6). Overall, 1638 (43.4%) and 3032(80.3%) participants reported never having used ICTs for research on general health and oral health topics respectively because of lack of time 554 (33.8%) (Table 6).

Table 6:Overall assessment of the impact of ICTs on participants' skills and practices

Level	**Before digital awareness** N (%)	**After digital awareness** N(%)
Insufficient [0-10]	2850(75.44)	1470 (38.91)
Fair [10-12]	396(10.48)	150(3.97)
Good enough [12-14]	131(3.44)	942 (24.93)
Good [14-16]	134(3.55)	570(15.10)
Very good [16-18]	267(7.09)	302(7.99)
Excellent [18-20]	0 (0.0)	344(9.10)
Total	3778(100.0)	3778(100.0)

Overall, 3032 (80.3%) participants had never used ICTs to conduct research on oral health. The main reason was "lack of time"; 586(19.3%) participants of the study population.

There was no significant association between marital status (p=0.256), gender (p value=0.1096) and the use of ICTs for oral health research. At the end of the awareness-raising, 3506 (93%) of the study participants, recommended the continuation of such a project (Table 7).

Table 7: Association between Daily online availability and sociodemographic characteristics of study participants

Variables		**Daily Online Availability**				**P-value**
		Between 1h-2h	**Between 3h-5h**	**Between 5h-10h**	**Always connected**	
Sex	Female n (%)	106 (22.1)	694 (48.1)	354 (31.5)	312 (42.6)	**<0.001**
	Male n (%)	374 (77.9)	748 (37.4)	770 (68.5)	420 (57.4)	
Profession	Informal n (%)	66 (13.8)	230 (16.0)	252 (22.4)	86 (11.7)	**<0.001**
	Formal n (%)	150 (31.3)	262 (18.2)	90 (8.0)	114 (15.6)	
	Employee n (%)	62 (12.9)	350 (24.3)	40 (3.6)	2 (0.5)	
	Unemployed n (%)	60 (12.5)	126 (8.7)	242 (21.5)	124 (16.9)	
	Student n (%)	24 (5.0)	148 (10.3)	258 (23.0)	398 (54.4)	
	Worker n (%)	50 (10.4)	60 (4.2)	0 (0.0)	0 (0.0)	
Marital status	Married n (%)	242 (50.4)	730 (50.6)	402 (35.8)	166 (22.7)	**<0.001**
	Single n (%)	134 (27.9)	430 (29.8)	540 (48.0)	542 (74.0)	
	Divorced n(%)	20 (4.2)	150 (10.4)	88 (7.8)	24 (3.3)	
	Widow/Widower n (%)	84 (17.5)	132 (9.2)	94 (8.4)	0 (0.0)	
Level of education	School dropouts n (%)	68 (14.2)	284 (19.7)	44 (3.9)	0 (0.0)	**<0.001**
	Primary level n (%)	42 (8.8)	116 (8.0)	100 (8.9)	48 (6.6)	

	Secondary level n (%)	66 (13.8)	358 (24.8)	180 (16.0)	130 (17.8)	
	University n (%)	304 (63.3)	684 (47.4)	800 (71.2)	554 (75.7)	
Age (years)	[18-25] n (%)	62 (12.9)	290 (20.1)	254 (22.6)	426 (58.2)	**<0.001**
	[26-35] n (%)	114 (23.8)	432 (30.0)	352 (31.3)	246 (33.6)	
	[35-45] n (%)	16 (3.3)	272 (18.9)	54 (4.8)	60 (8.2)	
	[46-55] n (%)	90 (18.8)	266 (18.4)	360 (27.6)	0 (0.0)	
	[56-65[n (%)	198 (41.3)	182 (12.6)	154 (13.7)	0 (0.0)	

Elements preventing the use of ICT as a medical resource

Group 1: Participants who do not see the use of ICTs as a tool for improving medical knowledge

Table 8: Reasons that prevent participants from viewing ICTs as an oral health awareness resource

Reasons	Number of participants	Percentages(%)
Misleading information	581	34.2
Distraction	240	14.1
Presents risks	159	9.4
Don't know.	131	7.7
Cybercrime	125	7.4
Lack of time	109	6.5
Distrust	70	4.1
Un-interesting	67	3.9
Never thought about it.	44	2.6
No need	42	2.5
Difficult to use	41	2.5
Prefers hospital	26	1.5
Bad experience	24	1.4
Ineffective	21	1.2
Dissatisfaction	18	1.1
Total	1698	100.0

Among study participants, 1698 (44.94%) did not see the use of ICT as a useful tool for improving oral health knowledge. The main reason given was "misleading information" 580(34.2%), while 18(1.1%) gave "dissatisfaction" as the reason (Table 8) .

Group 2: Participants who had never done research on an oral health topic

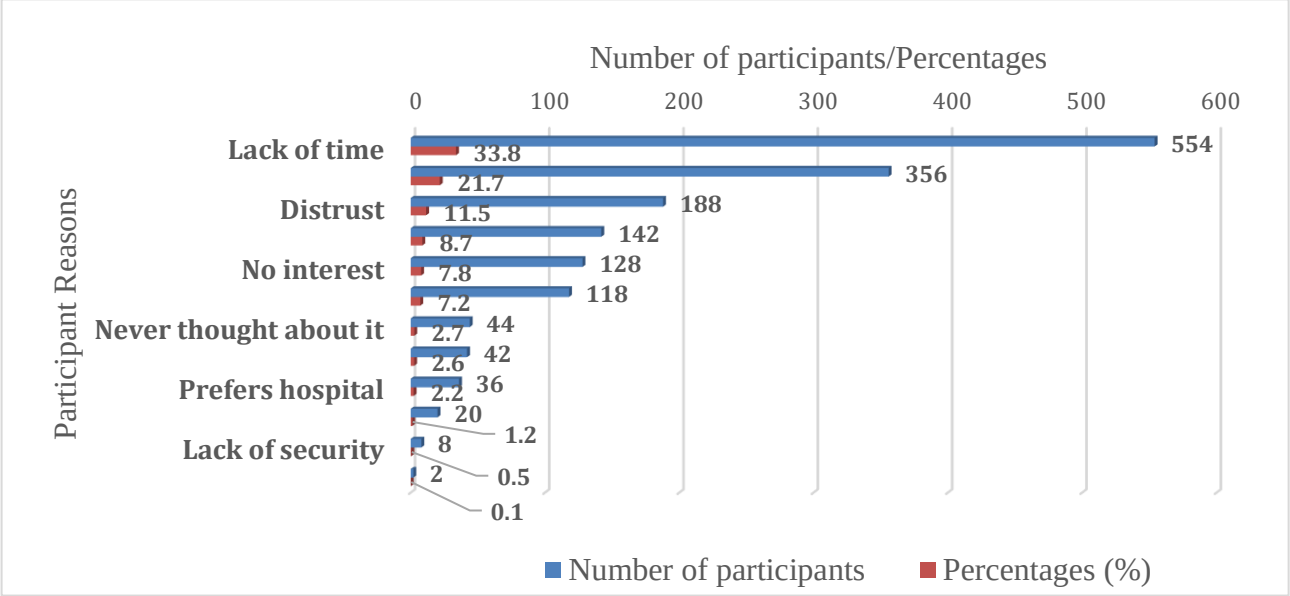


Figure 1: Reasons that prevent participants who have never done health-related research from participating

Overall, 1638 (43.4%) participants reported never using ICTs for research on an oral ealth topic with the main reason being lack of time554 (33.8%) (Figure 5).

Discussion

Oral health is an important component of the health and well-being of an individual. Despite that fact that oral diseases can be prevented, many people continue to suffer unnecessarily from the pain and discomfort that accompanies these conditions. This is due to many factors such as the poor access to oral health care services, high cost of oral care, the low priority given to oral health which leads to a lower perception of needs and as well as low oral health literacy (9,10). To address this major public health problem, accessible, acceptable, and effective preventive community-based approaches based on the behavioural changes of every individual in society are needed and ICTs are perfectly suited to assist.

Sociodemographic profile and ICT use

Globally with Cameroon not exempted, men are more likely to own and use mobile phones and have access to the internet than women (11**)**. This disparity is influenced by socioeconomic factors, cultural norms, and educational opportunities as women often face barriers such as lower income, limited digital literacy, and societal expectations that prioritize men's access to technology (12. 13). This is confirmed in this study, where two-thirds of study participants were males.

In the current study, more than half of the study population were aged between 16-35 years, they are the target age group for habit change. This group of individuals are referred to as the millennials, and is the age group that grew up during the rise of the internet and digital technology, making them highly proficient and comfortable with using various digital tools and platforms (14). Additionally, these young adults see ICT as an extension of their social and professional lives, using platforms to build networks while older generations tend to be more sceptical of new technologies and are slower to adopt them (15). Consequently, this age group can serve as a good target for oral health education especially as they represent a larger population with the highest literacy rate.

Two thirds of the participants in our study had attended university or had some other form of higher education. Basic education is a prerequisite for health education especially in operating tools used in the ICT as information is crucial to have correct medical or oral health knowledge(16)(15). In recent decades, the transmission and exchange of information has been revolutionized by the advent of the internet and ongoing developments in information and communication technology (ICT) (15).

Reasons for not using ICT tools

Most participants (80.3%) had never used ICT for oral health education. This reflects the low penetration of oral health information in Cameroon and demonstrates that insufficient attention is given to oral health care in the country. This is further exacerbated by the fact that in Cameroon, the government puts greater emphasis on infectious and endemic diseases that have high mortality and morbidity rates (9). Furthermore, 12.4% reported that oral health was not a major issue and 12.1% that it was “uninteresting ".

The present study found that ICT terminals most used by participants in order of importance were: Smartphones (43.19%), Computers (36.07%), Digital tablets and Others (health blogs) (5.53%). The pre-test phase found 45% of participants did not consider ICT as an essential medical resource, with 34.2% citing that too much misleading information is circulating on the internet, 19.3% did not have time for surfing the net.

Impact of oral health education using ICT

After 2 months of oral health education through the internet all their scores increased so dramatically and with positive knowledge responses above 90%, which shows that ICT improved their knowledge. This confirms that oral health education through the internet can have a significant impact on oral health practices and behaviours of the population (17).

Nowadays with access to ICTs, many people search the internet for health information (14). In the present study, there was a significant association between medical history and the use of ICT for research on a health topic ($P = 0.003$). This tendency may result from a desire for privacy, the need for informed decision-making, and the convenience of online resources (18)**.** The present study showed a significant improvement in behavioural outcomes (48.42%) and knowledge (71%) among participants. The average knowledge test score increased from 6.18 ± 3.79 to 18.13 ± 2.72. This improvement was most likely due to the consistent engagement with the study’s educational applications, the provision of regular health information and encouragement of

participants to apply what they learned. The combination of accessible information, and effective communication proved effective in promoting oral health.

The application significantly improved participants' oral health-seeking behaviour as before the awareness phase, 73.66% had never consulted a dentist, but after two months of education, 90.6% expressed the need to see a dentist, mainly for an oral assessment. This further highlights the potential of ICT tools in promoting positive oral health-seeking behaviour in the general population (15).

Our study revealed that there was a significant association between participants' internet usage time and their sociodemographic profile (age, sex, education level, occupation, marital status, and region of origin), with a p-value < 0.001 for each factor. This is linked to the fact that younger people and those with higher education levels are usually more apt with technology, and more likely to turn to the Internet for health information. Women often take a more proactive approach to health research, and men's work-related internet use can also play a role. Married individuals often search for health information for themselves and their families (19). There was no significant association between ICT use for general health, sex, and marital status.

Conclusion

The present study highlights the effectiveness of ICT in promoting oral health among adults in Cameroon. Raising awareness improved oral hygiene knowledge and practices, while fear of misinformation and lack of time were key barriers. To enhance oral health promotion, long-term studies on prevention, tailored digital sensitization protocols, secure digitization of medical records, and improved digital infrastructure to expand access and strengthen public health initiatives should be researched.

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